Regional Wastewater
Services Plan

Brightwater Facilities

Project Status
Value Engineering Analysis
Phasing Analysis

August 2004

King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

This information is available in alternative formats upon request by calling 206-684-1280 (voice) or Relay Service 711 (TTY).

Contents

Executive Summary

On June 17, 2004, the King County Council adopted Ordinance 14942, which established the 2005 sewer rate and capacity charge for the next two and three years, respectively. The Ordinance also identified a set of quarterly reporting requirements to provide the Council with the latest cost information for Brightwater. The first report was required to provide the following information.

- A phasing analysis and phasing options for the Brightwater project
- The latest cost estimates and impacts on rates and capacity charges
- A value engineering analysis and resulting potential cost savings

This report partially satisfies these requirements. It presents a complete phasing analysis that describes the impacts of deferring the Brightwater on-line date. The Brightwater cost estimates are still being finalized and are not included in this report; however, the report does discuss issues that affect Brightwater costs, including inflation and the recent unprecedented increase in the price of commodities. The value engineering recommendations are still under review but will be finalized soon. Accordingly, the King County Executive will submit an addendum to this report in late September that includes the final cost estimates for the Brightwater system as well as the final recommendations from the value engineering analysis, including the associated cost impacts.

What's in This Report

This Executive Summary presents an overview of each of the major sections in this report, followed by the Introduction, which describes the current status of the Brightwater project, reviews expenditures to date, and summarizes recently updated population and flow projections. The report continues with four main sections: the first describes issues affecting the Brightwater costs, the second presents the preliminary value engineering recommendations, the third describes the construction schedule and risk, and the fourth presents an analysis of deferring the Brightwater on-line date. The final section presents conclusions based on the information presented in this report. Appendix A summarizes the findings of the recently updated population forecasts and flow projections.

Brightwater Status

King County DNRP accomplished a significant amount of work on the Brightwater project in the last year, helping to ensure that the project remains on schedule to provide needed wastewater capacity to the regional system by the year 2010. The predesign documents and cost estimates are slightly behind schedule but the majority of the engineering analysis has been completed. In addition, project staff applied for many of the permits needed to support the project and many new employees were

hired to carry out the project's design and construction phases. The public involvement program continued to involve stakeholders and members of the public in the Brightwater design and permitting process.

The key activities currently underway include completing the predesign cost estimates, continuing the permitting process, and beginning final design on the treatment plant and conveyance system. These activities are expected to continue through mid-2006. As part of final design, there will be opportunities for public participation on the treatment plant design, permitting, and mitigation. King County DNRP will open a project office at the Route 9 site in Woodinville this fall.

Issues Affecting Brightwater Costs

This report describes two primary issues that will affect the Brightwater cost estimates: the cost of inflation and the recent increase in the cost of construction materials. The report also describes options for financing the Brightwater project in the long term.

Inflation

Inflation is an increase in the overall level of prices over a period of time reflecting the future decrease in the purchasing power of today's dollars. During the period 2001 through 2003, the cost estimates for the Brightwater project have remained stable at approximately $1.35 billion. Table 1 shows that, during that time, inflation of 3 percent per year would have increased the project budget by approximately $82 million. This increase has been offset by cost savings identified during the design of the Brightwater treatment and conveyance systems. King County DNRP will continue refining the design to identify cost savings to help balance the cost of inflation.

Table 1

Inflation Offset by Brightwater Cost Savings (millions)

	9/2001 Preliminary Estimate	11/2002 Brightwater DEIS	11/2003 Brightwater FEIS
Base Cost Estimate[a]	$1,350	$1,350	$1,350
2001 Cost Estimate w/ 3% annual inflation	$1,350	$1,390	$1,432
Inflation offset by cost savings	$0	$40	$82

[a] Brightwater cost estimate in dollars of the year indicated

[b] Reflects the cost of inflation in 2004 from base cost estimate

Commodity Prices

Since the beginning of 2004, the construction commodity market has increased to record levels. Through July 2004, structural and reinforcing steel represented some of the largest price increases from last year, with structural steel running 23.3 percent higher and reinforcing steel at 42.1 percent higher. These materials make up a major component of the Brightwater facilities, and the recent increase in price of these materials will likely have a significant impact on the Brightwater cost estimates.

Preliminary VE Recommendations

An important aspect of the Brightwater predesign process was the value engineering (VE) review. Between January and March 2004, a VE team conducted a review of the Brightwater facilities and made a number of recommendations. Between March and June, the Brightwater design team reviewed the VE recommendations, along with input from the Metropolitan Water Pollution Abatement and Advisory Committee (MWPAAC) and the King County Regional Water Quality Committee (RWQC). A review of the value engineering recommendations is currently being finalized. A specific accounting of the accepted VE recommendations and associated cost impacts for the Brightwater treatment and conveyance system will be included in an addendum to this report in late September. The major VE recommendations are summarized below.

Treatment Plant

- Consolidate the site plan to achieve reductions in gallery facilities, site work, piping, pumping, and hydraulics
- Eliminate the ballasted sedimentation process and revise the conventional primary sedimentation process to operate as chemically enhanced primary clarification (CEPC) to treat peak flows

Conveyance System

- Defer construction of tunnel from the South Kenmore Portal (11) to the North Kenmore Portal (44); delay construction of the South Kenmore Portal (11)
- Separate the 24-foot-diameter tunnel between the North Kenmore Portal (44) and the North Creek Portal (41) into two 14-foot diameter parallel tunnels
- Locate the Influent Pump Station at Portal 41

Construction Schedule and Risk

The Brightwater project is currently on schedule to provided needed wastewater capacity to the north service area by October 2010. Based on the June 2004 construction schedule, the Brightwater system will be completed in October 2010. However, there are risks associated with the construction of a large, complex capital project such as Brightwater, including delays in obtaining permits, problems with tunneling, or difficulties in acquiring needed easements or property. To provide contingency to help mitigate such risks, King County DNRP conducted a phasing analysis to evaluate alternate on-line dates for Brightwater, as describe below.

Phasing Analysis

In April 2004, the King County Executive released the *Regional Wastewater Services Plan Update*, which reviewed the last 3 years of RWSP implementation to evaluate the assumptions used to develop the RWSP, including population and flow projections, the phasing and timing of facilities, and the effectiveness of RWSP policies. The Update confirmed that, overall, the original RWSP assumptions are still valid and the need for Brightwater by 2010 is unchanged. Accordingly, the Executive did not recommend any significant changes to the RWSP policies or major reconfigurations of the approved RWSP. However, DNRP staff conducted a phasing analysis to evaluate alternate on-line dates for Brightwater for the years 2010–2014. This analysis found that the project could be delivered cost effectively between 2010 and 2012, but by 2013 there is inflationary risk and by 2014 costs began to substantially increase. The phasing analysis also found that the King County Executive has flexibility within the years 2011–2012 to mitigate risks that may cause delays during design, permitting, and construction without paying a premium to get back on schedule. This extended timeframe could also allow the Executive to optimize the construction schedule for Brightwater to increase efficiency, save costs, and lessen rate and capacity charge impacts.

Conclusions

The Brightwater project is currently on schedule to provide needed wastewater capacity to the north service area by October 2010. This report suggests that, based on an analysis of system capacity, available storage, construction sequencing, and impacts to monthly rates and the capacity charge, the King County Executive has the flexibility to adjust the final Brightwater completion date between 2010 and 2012. This flexibility will allow the Executive to accommodate delays or mitigate risks without paying a premium to get back on schedule, as well as to take advantage of potential opportunities to react to market conditions, employ labor efficiently, and smooth cash flows in peak construction years. Accordingly, the Executive will continue with the present schedule to complete Brightwater in the fall of 2010 and use the available flexibility as needed to construct Brightwater as efficiently and cost effectively as possible.

Introduction

The purpose of this report is to meet the reporting requirements outlined in Ordinance 14942. This first report provides a project update and summarizes the recommended design changes to the Brightwater system resulting from a value engineering analysis conducted in early 2004. A phasing analysis is presented as well, including an analysis of storage capacity in the Brightwater conveyance system—with associated rate and capacity charge impacts—and an analysis of the optimal sequence for constructing the Brightwater Treatment Plant. The report also presents the current construction schedule and describes risks and other circumstances that could impact the scheduled Brightwater completion date.

This Introduction begins with a description of the current status of the Brightwater project, including activities completed or underway since January 2003, and continues with a summary of Brightwater expenditures to date. The Introduction concludes with a synopsis of the capacity needs of the regional system, which sets the stage for the phasing analysis that follows later in the report.

Brightwater Project Status

King County DNRP accomplished a significant amount of work on the Brightwater project in the last year, helping to ensure that the project remains on schedule to provide needed wastewater capacity to the regional system by the year 2010.[1] The predesign documents and cost estimates are slightly behind schedule but the majority of the engineering analysis has been completed. In addition, project staff applied for many of the permits needed to support the project and many new employees were hired to carry out the project's design and construction phases. The public involvement program continued to involve stakeholders and members of the public in the Brightwater design and permitting process. These activities are described in more detail under the headings that follow.

The key activities currently underway include completing the predesign cost estimates, continuing the permitting process, and beginning final design on the treatment plant and conveyance system. These activities are expected to continue through mid-2006. As part of final design, there will be opportunities for public participation on the treatment plant design, permitting, and mitigation. King County DNRP will open a project office at the Route 9 site in Woodinville this fall.

[1] For a detailed review of Brightwater implementation to date, see the Regional Wastewater Services Plan Annual and Semi-annual reports at http://dnr.metrokc.gov/wtd/rwsp/library.htm

Predesign

Following adoption of the final Brightwater alternative in December 2003, King County DNRP began the predesign phase of the project, which refined the conceptual design presented in the FEIS to 30 percent design. Predesign evaluates more specific and substantial information relating to technology process alternatives, facility size and layout, capacity, hydrology, geology, environment, and cost. The Brightwater predesign process is nearly complete and will result in a set of detailed design drawings that will be used to refine the project's construction cost estimates and develop construction bid packages. Figures 1 and 2 show the major components of the Brightwater treatment and conveyance system, respectively. The specific VE recommendations and associated cost savings are presented later in this report.

Permitting

Securing the permits necessary to develop and construct the Brightwater facilities has been one of the primary activities undertaken by DNRP in 2004. Staff have applied for many of the required systemwide permits at the federal and state level, including Section 404 of the CWA and Section 7 of the Endangered Species Act. These permits regulate the discharge of dredged material, placement of fill material, or excavation within waters of the United States and regulate impacts to endangered species and their habitat, respectively. DNRP has also applied for a Hydraulic Project Approval (HPA) permit and a National Pollutant Discharge Elimination System (NPDES) permit.

Staffing

In October 2003, DNRP developed a staffing plan that outlined the staffing necessary to support the major RWSP projects entering design and construction between 2003 and 2005—primarily the Brightwater facilities.[2] The staffing plan identified the need for approximately 22 employee equivalents for continued program management, design, construction management, SEPA compliance, community relations, right-of-way/permitting, and environmental & technical analysis. As of June 2004, 18 employee equivalents had been hired.

[2]. October 2003. *Regional Wastewater Services Plan Phase II Staffing Plan: Brightwater Facilities*. King County Department of Natural Resources and Parks, Wastewater Treatment Division.

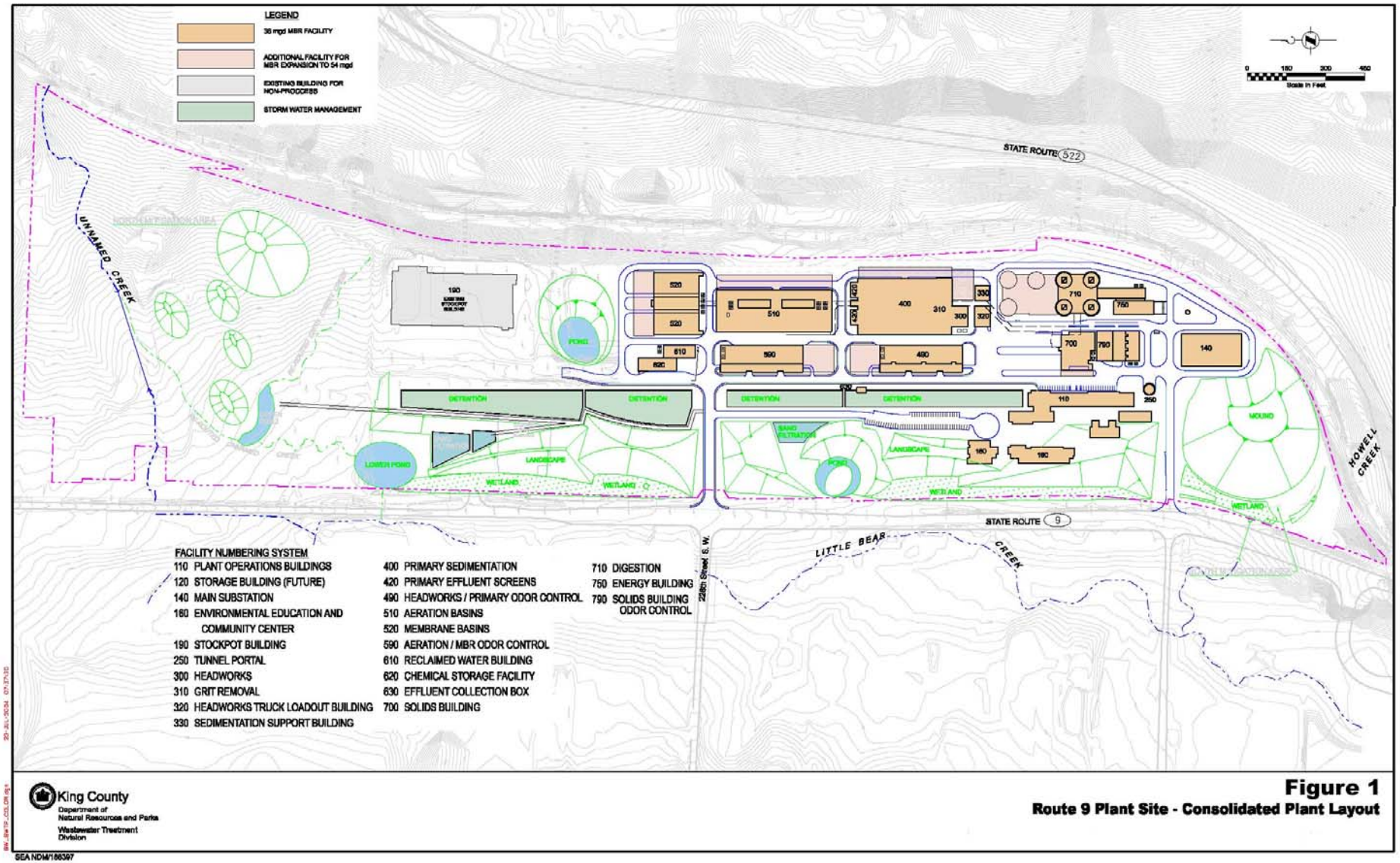


Figure 1
Route 9 Plant Site - Consolidated Plant Layout

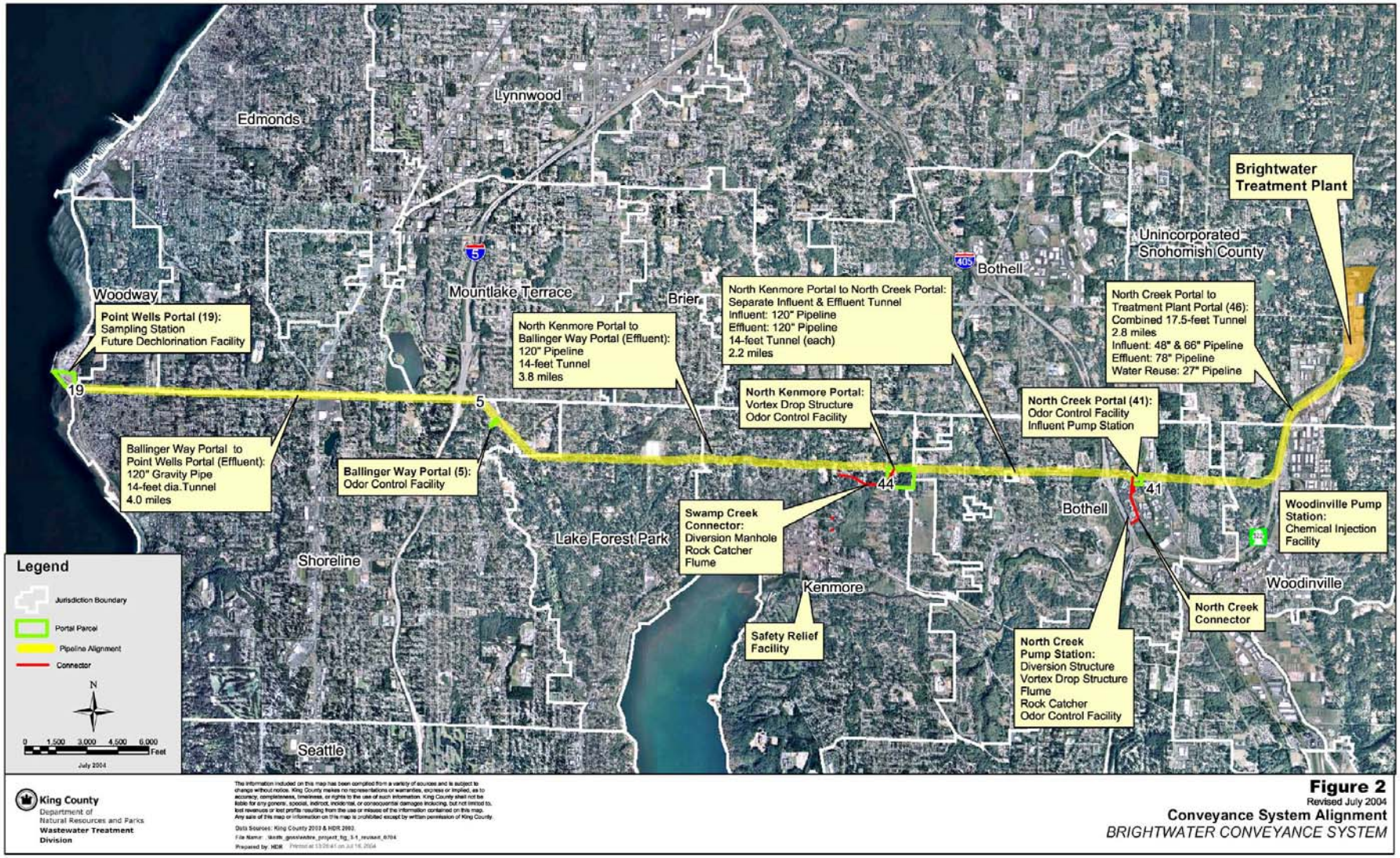


Figure 2
Revised July 2004
Conveyance System Alignment
BRIGHTWATER CONVEYANCE SYSTEM

Public Involvement

King County DNRP continues to place a high priority on involving stakeholders and members of the public in the Brightwater design and permitting process. A number of public meetings were held since January along with the continuation of ongoing activities such as quarterly newsletters, speakers' bureau, and the Web site. In addition, the Brightwater public involvement program was recognized in 2004 with two awards. The first was the public involvement process during the four-year Brightwater Siting Project received the International Association for Public Participation's Core Values Project of the Year award. The second award was for the Brightwater Web site, which received the Association of Metropolitan Sewerage Agency's (AMSA) National Environmental Education Achievement Public Information and Education award.

Contract Delivery

King County DNRP selected Hoffman Construction Company as the General Contractor/ Construction Manager (GC/CM) for constructing the Brightwater Treatment Plant. DNRP expects the conveyance system to be constructed using a design-bid-build contract delivery method, with the first contract package expected to go to bid in late June 2005. It is anticipated that the marine outfall will be constructed using a design-build method, with bids expected in mid-2007.

Brightwater Expenditures to Date

For the period January 1998 through June 2004, approximately $121 million has been spent on the Brightwater project. The most significant expenditures to date include planning and siting the Brightwater facilities, predesign, land acquisition, and labor, as shown in Table 2. The planning/siting activity reflects costs for the four-year process to site the Brightwater facilities, including the development of the draft and final environmental impact statements and conceptual engineering. Predesign includes engineering through 30 percent design, as described above, and many of the properties and easements needed to construct the Brightwater treatment and conveyance system have been purchased.

Table 2
Brightwater Expenditures to Date

Brightwater Activity	Life to Date Cost (Cumulative Actual Dollars 1998-2004)
Planning/Siting	$29,686,758
Predesign	$23,144,174
Design	$9,281,606
Implementation	$1,017,179
Permitting and Other Agency Support	$7,011,637
Right of Way/land acquisition	$32,485,834
Miscellaneous Services & Materials	$4,551,659
Staff Labor	$14,553,555
Credits/revenues	$325,268
Total	**$121,213,399**

Updated Population and Flow Analysis

To identify future wastewater facility needs in its service area, DNRP staff project future wastewater flows based on population and employment forecasts provided by the Puget Sound Regional Council (PSRC). The Regional Wastewater Services Plan was developed using PSRC data based on the 1990 census. In 2003, DNRP reevaluated its population projections using PSRC data from the 2000 census and found that that the updated forecasts were only 4 percent below the RWSP forecasts for the period 2000 to 2030. This analysis confirmed the need for having Brightwater on line by the year 2010. Other findings include:

- Peak 20-year flows in the Brightwater service area in 2000 are 4 percent higher overall than previously estimated
- Some basin flows to the Kenmore Interceptor are higher than anticipated
- Capacity in the conveyance system leading to existing County treatment plants may be exceeded earlier than anticipated
- When it comes on line in 2010, the Brightwater system will alleviate conveyance system constraints at the north end of Lake Washington

A more detailed discussion of the updated population and employment forecast and the revised flow projections is presented in Appendix A.

Issues Affecting Brightwater Costs

In December 2003, King County developed cost estimates for the three system alternatives evaluated in the Brightwater FEIS. These estimates reflected conditions at conceptual design (approximately 10 percent design). The conceptual design was subsequently refined during the predesign process, which takes the project through 30 percent design. And while the majority of the engineering analysis has been completed, the predesign documents and cost estimates are slightly behind schedule. As such, the cost estimates will be presented in an addendum to this report in late September.

Inflation

Inflation is an increase in the overall level of prices over a period of time reflecting the future decrease in the purchasing power of today's dollars. During the period 2001 through 2003, the cost estimates for the Brightwater project have remained stable at approximately $1.35 billion. Table 3 shows that, during that time, inflation of 3 percent per year would have increased the project budget by approximately $82 million. This increase has been offset by cost savings identified during the design of the Brightwater treatment and conveyance systems. King County DNRP will continue refining the design to identify cost savings to help balance the cost of inflation.

Table 3

Inflation Offset by Brightwater Cost Savings (millions)

	9/2001 Preliminary Estimate	11/2002 Brightwater DEIS	11/2003 Brightwater FEIS
Base Cost Estimate[a]	$1,350	$1,350	$1,350
2001 Cost Estimate w/ 3% annual inflation	$1,350	$1,390	$1,432
Inflation offset by cost savings	$0	$40	$82

[a] Brightwater cost estimate in dollars of the year indicated

[b] Reflects the cost of inflation in 2004 from base cost estimate

Commodity Pricing

Since the beginning of 2004, the construction commodity market has increased to record levels. Construction commodity prices and inflation are being driven by global markets including China, which has put an unprecedented demand on raw materials overseas. Furthermore, according to the Department of Commerce, public construction is on the rise across the country with the volume of sewage project construction increasing 7.7 percent from last year. These demands, when combined with the recent increases in crude oil prices, have resulted in every major construction cost composite index recording inflation at exponential levels with some recording between three to six times the inflation rate from last year.

The increase in commodity markets began in the first quarter of 2004 when scrap steel price increases drove up the prices of steel construction materials. Through July 2004, structural and reinforcing steel represent some of the largest price increases from last year with structural steel running 23.3 percent higher and reinforcing steel at 42.1 percent higher than last year. Reinforcing steel, concrete, ductile iron pipe and reinforced concrete pipe have increased in price from 6.3 percent to 42.1 percent from last year and are major materials projected for use with the Brightwater facilities. Table 4 below highlights some of the key materials used for the Treatment Plant and Conveyance facilities with their associated annual (12 month) increases from last year.

Table 4
Key Specific Material Price Indexes

Material	Annual Increase
Structural Steel	23.3%
Reinforcing Steel	42.1%
Ready Mix Concrete	9.7%
Asphalt Paving	1.5%
Ductile Iron Pipe	14.7%
Reinforced Concrete Pipe	6.3%
PVC Water Pipe	6.0%
Corrugated Steel Pipe	9.2%
Lumber	28.0%
Plywood	25.4%

Source: ENR 20-City Averages July 2003 to July/August 2004

To some extent, the increases in material demands have suppliers increasing margins for construction commodities, which further drives up prices. This type of peak material pricing trend was last experienced in the mid- and late-1970s. The difference between the 1970's and the current peak is that global market demand was not a factor in the increase. Nevertheless, an analysis of how the market responded after the peaks in the 1970's may provide a historical trend for reference.

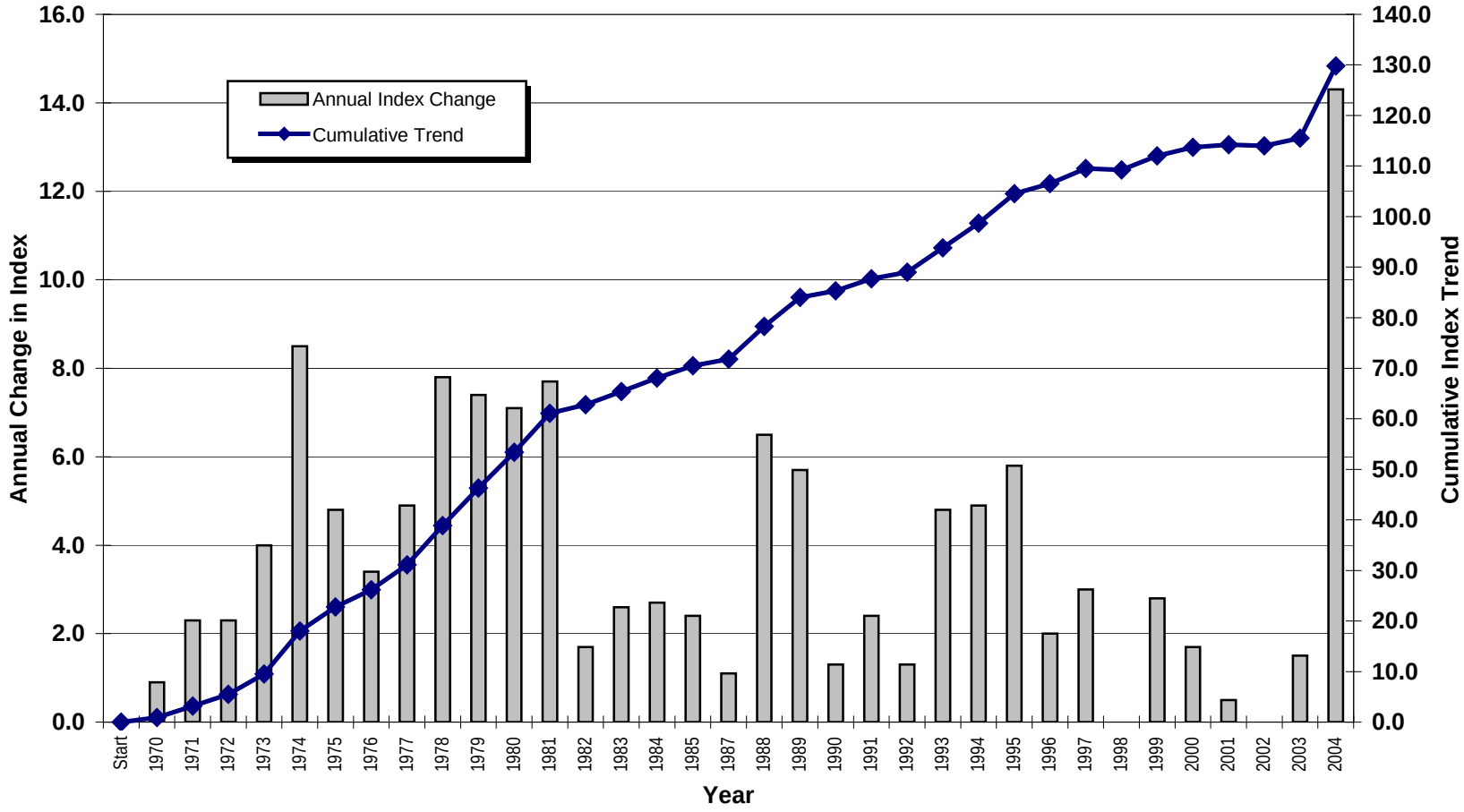
Figure 3 illustrates the Construction Material Producer Price Index trend from 1970 to 2004. Officially titled the "Materials and Components for Construction," this is a composite index and is published monthly by the Bureau of Labor Statistics. It measures price changes from the perspective of the seller and is a standard economic indicator for a subset of commodities. Historically, this index has tracked domestic construction material pricing since 1947. Figure 3 represents the mid-year (end of June) indexes for each year to facilitate a direct comparison to the current mid-year 2004 data point since 1970. Notably, the June 2004 annual index increase of 14.3 is the single highest increase in the history of the index. The next highest increase ever recorded was in 1974, which recorded a jump of 8.5. The peak in 1974 was followed by three years of increases, but at reduced levels of between 40 percent and 57 percent of the peak. The next highest peak was in 1978, which was followed by 3 years of similar inflation levels. It is difficult to draw predictions from previous historical trends; however, one trend is consistent from the index since 1947: the index has never adjusted down negatively after a peak year to normalize to the pre-peak inflation level. In fact, the index only dropped into negative inflation 8 times since 1947 and only after downward trends and never by more than 1.2 percent. Accordingly, it is unlikely that the commodity prices will adjust down to 2003 levels.

Construction labor is currently trending at a 2.7 percent increase for skilled labor and a 3.8 percent increase for common labor. While this is slightly higher than the previous 5 years, it does not represent as large an increase as the construction commodity market trend. Accordingly, material pricing is accounting for the greatest inflationary cost increase to the Brightwater facilities. In general, at an aggregate composite level, material pricing has increased 9.3 percent from last year. However, the impact to the Brightwater facilities is greater as the major materials of reinforcing steel, concrete, and piping have increased in price from between 6.3 percent to 42.1 percent from last year. The specific impact of commodity price increases will be outlined in the September addendum to this report.

Long-term Financing

In the adopted Regional Wastewater Services Plan, the King County Council included specific policies related to financing. These policies were originally outlined in King County Ordinance No. 13680, Section 16, and amended by King County Ordinance No. 14219, Section 3. With respect to the RWSP, the essence of these policies is that "growth should pay for growth." Through these policies, customers representing new connections to the wastewater system will pay for the cost of expanding capacity through the combined revenues of their monthly sewer rate and capacity charge. The capacity charge is a monthly fee that is assessed to all newly connecting customers—residential, commercial, and industrial—to the King County wastewater system. Newly connecting customers have the option to pay King County biannually over 15 years or to pay an up front charge that represents a discounted value (currently 5.5 percent) of the 15 years of biannual payments.

Figure 3
Construction Material Producer Price Index Trend
Source: Bureau of Labor Statistics



Because the Brightwater facilities are being sized to serve long-term service area growth through Year 2030, by definition the accumulation of capacity charge fees alone will not be adequate within the construction time frame to fully fund construction of Brightwater facilities by the year 2010. King County therefore will fund the capital portion of the cost through a combination of capacity charges, a portion of the annual revenue from the monthly sewer service rate, the sale of new revenue bonds, and the potential use of State Revolving Fund and other low interest loans. The ongoing costs of operating and maintaining the new facilities will be fully funded by the monthly wholesale user rate.

As the final design, schedule, and costs are refined, DNRP will explore a number of financing options to optimize our debt service payment patterns to help smooth the rate impacts over time. Any financing options proposed will need to incorporate an analysis of the current financial market conditions, total utility debt and financial performance and the assessment of the bond rating agencies with respect to the use of the different bond structures. The King County Executive will include specific financing options in future rate and capacity charge proposals. Examples of possible financing options are listed in Table 5.

Table 5
Financing Options

Financing Option	Form of Long-term financing	Interest Cost	Interest Rate Risk	Debt Service Deferral Period	Effect
Amortize Principal Immediately	Current Interest Bonds	Least expensive	No, long-term financing locked in immediately	Up to 12 months	Current practice
Deferred Principal Amortization	Current Interest Bonds	Slightly more expensive than #1	No, long-term financing locked in immediately	Up to 12 months	Small long-term rate impact
Deferred Interest and Principal Amortization	Zero Coupon Bonds	Most expensive	No, long-term financing locked in immediately	2-30 years	Larger long-term rate impact depending on premium.

Value Engineering Analysis

One important aspect of predesign for large, complex projects like Brightwater is value engineering (VE). Value engineering is a process to review and challenge a project's design elements, including the underlying assumptions and methodologies, to increase value within the design by improving performance, reliability, quality, safety, and reducing life-cycle costs. Between January and March 2004, a team of independent experts conducted a VE review of the Brightwater facilities at the 20 percent design stage and made initial recommendations for the treatment plant and conveyance system. Between March and June, the design team completed a review of alternatives, including input from Metropolitan Water Pollution Abatement and Advisory Committee (MWPAAC) and the King County Regional Water Quality Committee (RWQC), and incorporated the final VE recommendations into the final design scope of work.

This section presents some of the major value engineering recommendations for the Brightwater treatment plant and conveyance system that will be incorporated into the final design. A more detailed review of the VE recommendations and their associated cost impacts will be provided in an addendum to this report in late September.

Treatment Plant VE Recommendations

The primary VE-related design changes between the FEIS and 30 percent design for the treatment plant included consolidating the site plan, revising the primary treatment processes, and controlling odors.

Consolidated Site Plan

The Brightwater FEIS schematic design presented a relatively open layout for the process facilities. The value engineering team suggested consolidating the site plan to achieve reductions in gallery facilities (throughways for piping and electrical conduit), site work, pumping, and hydraulics. This consolidation will also optimize cut and fill operations.

Changes to Primary Treatment Process

Several VE recommendations dealt with primary treatment. A significant one was to eliminate the ballasted sedimentation process and revise the conventional primary sedimentation process to operate as chemically enhanced primary clarification (CEPC) to treat peak flows. This change led to the implementation of other recommendations, including the addition of four additional conventional primary clarification tanks (nine vs. five) to allow both CEPC and conventional processes, as well as the use of an aerated grit removal system instead of the vortex system specified in the FEIS.

Odor Control

There were a number of different VE recommendations related to odor control for specific process areas.

- Headworks and Primary Clarification: the 30 percent design shows 5 odor control trains for the headworks and primary clarification area
- Aeration and Membrane Bioreactor: a VE recommendation was accepted to recirculate foul air through the membrane basins as agitation air. This resulted in a significant reduction in odor control equipment for secondary treatment functions
- Solids Handling: the VE team recommended reducing the size of the solids building would to reduce the volume of air to treat, which would require fewer odor control units
- Digesters: the digester carbon odor control system was eliminated based on a VE recommendation and the follow-up work to ensure positive control of fugitive gas emissions
- Covers: the covers on the primary sedimentation tanks are considered to be part of the odor control system. As a result of an increase in the size and number of primary clarifiers, the area of the covers will increase significantly from the conceptual estimate

Conveyance VE Recommendations

Several refinements were made to the conveyance design as a result of the value engineering review. Design refinements included changes in tunnel alignment, diameter, and length; portal design refinement and configuration, and associated earthwork excavation volumes and dewatering rates. The major VE-related design changes between the FEIS and 30 percent design were related to the influent corridor, as listed in Table 6 and summarized below. No major changes were recommended for the effluent corridor or the marine outfall.

Table 6

Major VE Changes for the Brightwater Influent Corridor

Element	Final EIS	30 Percent Design
South Kenmore Portal (11) to North Kenmore Portal (44)	120-inch pipeline (14-foot tunnel)	Defer South Kenmore Portal (11) and tunnel construction
North Creek Portal (41) to Treatment Plant Portal (46) (Combined Tunnel)	Two force mains (twin 96-inch) in the combined tunnel (24-foot tunnel)	Two force mains (66-inch & 48-inch) in the combined tunnel (17.5-foot tunnel)
Influent Pump Station	Potential for new pump station to be located at Portal 41 instead of at treatment plant	Influent pump station to be located at Portal 41

South Kenmore (Portal 11) to North Kenmore (Portal 44)

Several VE recommendations dealt with this pipe segment, such as reducing the size of Portal 11, using a cut and cover force main instead of a tunnel, and using an existing pipe segment as a carrier pipe for the force mains. Ultimately, the design team decided to defer the segment altogether based on updated population and flow information that suggested it was not needed in the near future to handle anticipated flows. The flows from these basins will be routed to West Point to take advantage of capacity available because of slower-than-expected population growth in the City of Seattle. West Point solids capacity is limited although some digester improvements are underway. DNRP will monitor this closely to ensure that West Point can handle these flows in the long term.

North Creek (Portal 41) to Route 9 Site (Combined Tunnel Segment)

The VE team recommended reducing the combined tunnel diameter from 24 feet to 14 feet and reducing the number of pipes to three influent lines and one effluent line. The design team was subsequently able to reduce the tunnel diameter to 17.5 feet with two influent lines and one effluent line. The design team committed to an approach that will establish a minimum size for the pipes that will go into the tunnel and allow the contractor to further reduce the size of the tunnel if performance criteria can be met, which could create additional opportunities for cost savings.

Influent Pump Station

At the time the Brightwater FEIS was issued, the Influent Pump Station (IPS) could have been at either the Route 9 site or at North Creek. The King County Executive decided to locate it at North Creek. The conceptual design for the IPS was under development at the time of the VE review, so there were no specific recommendations on the IPS. However, the IPS was reviewed in a separate VE session after the conveyance system review was complete, resulting in significant changes to the design and the continued development of a number of other alternatives. These changes, and associated cost impacts, will be presented in an addendum to this report in late September.

Construction Schedule and Risk

This section presents a summary of the construction schedule for the Brightwater Treatment Plant, conveyance facilities, and marine outfall. The schedule is current as of June 25, 2004, though it will be continually refined on a monthly basis through the end of construction. The activities presented for each component of the Brightwater system reflect the different contract delivery methods used to construct the facilities. This section also outlines potential risks that may affect the construction schedules.

Treatment Plant

Table 7 shows the major scheduling activities for the Brightwater Treatment Plant as of June 25, 2004. The scheduling flow begins with construction of the "North 40" mitigation area in the fall of 2005, followed by the completion of site work on the treatment plant site in the spring of 2007. Finally, the treatment plant process and buildings will be constructed, with an anticipated completion date of fall of 2010. Since there is some flexibility in the treatment plant schedule, the start dates may be modified to allow more time for some businesses to relocate and to minimize conflicts with the widening of Highway 9 being done by WSDOT.

Table 7

Treatment Plant Schedule as of June 25, 2004

Activity	Early Start	Early Finish
Treatment Plant		
60% design development & review	01 JUL 04	25 JAN 05
90% design development & review	29 NOV 04	31 AUG 05
100% design & construction documents	01 JUL 05	30 JUN 06
Treatment plant construction bid & award	03 JUL 06	27 DEC 06
Sitework construction	01 JUL 06	30 MAR 07
Treatment plant construction	28 DEC 06	01 OCT 10

Conveyance System

At this time, DNRP expects to construct the Brightwater conveyance system using the traditional design-bid-build approach. At present, there are 5 major components of the conveyance system: (1) the combined tunnel, (2) the influent/effluent tunnels, (3) the effluent tunnel, (4) the influent pump station, and (5) the associated above-ground conveyance facilities (such as odor control). Table 8 shows the schedule for major activities in each component, including the microtunnels and outfall. The tunnel segments will be constructed sequentially, with the first contract package for the combined tunnel going to bid in June 2005. One of the primary activities

Table 8

Conveyance Facilities Schedule as of June 25, 2004

Activity	Combined Tunnel		Influent/ Effluent Tunnel		Effluent Tunnel		Influent Pump Station		Conveyance Facilities	
	Early Start	Early Finish	Early Start	Early Finish	Early Start	Early Finish	Early Start	Early Finish	Early Start	Early Finish
60 % design review	01 JUL 04	26 NOV 04	01 JUL 04	26 JAN 04	16 DEC 04	09 SEP 05	01 JUL 04	08 MAR 05	01 SEP 04	28 JUN 05
Submit 60% design set	__	15 OCT 04	__	15 DEC 04	__	29 JUL 05	__	25 JAN 05	__	17 MAY 05
Prep/Process Grading permit	18 OCT 04	29 APR 05	16 DEC 04	15 JUN 05	01 AUG 05	31 JAN 06	26 JAN 05	12 OCT 05	18 MAY 05	13 JAN 06
90% design review	18 OCT 04	12 MAY 05	16 DEC 04	11 NOV 05	01 AUG 05	29 MAR 06	__	31 AUG 05	__	02 DEC 05
Submit 90% design set		31 MAR 05		30 SEP 05	__	15 FEB 06	01 SEP 05	01 JUN 06	05 DEC 05	16 AUG 06
Develop 100% design & final bid documents	01 APR 05	29 JUN 05	03 OCT 05	15 FEB 06	16 FEB 06	29 JUN 06	01 SEP 05	17 AUG 08	05 DEC 05	18 SEP 06
Bid & award	30 JUN 05	02 JAN 06	16 FEB 06	14 AUG 06	30 JUN 06	29 DEC 06	18 AUG 08	19 FEB 07	23 JUL 07	22 JAN 08
Construction	03 JAN 06	26 FEB 10	15 AUG 06	05 JUL 10	01 JAN 07	19 JUL 10	11 JUL 08	09 SEP 10	23 JAN 08	19 AUG 10

currently underway for conveyance team is optimizing the contract packages for the bid process. This effort involves a detailed construction sequencing analysis of the entire conveyance system based on the 30 percent design drawings. The sequencing analysis will determine the best construction "flow" for the conveyance system and will likely result in contract packages that combine some of the five components. These final contract packages will then drive the future design and permitting effort for the conveyance system. The expected completion of the conveyance system is September 2010.

Marine Outfall

King County DNRP anticipates that the marine outfall will be constructed using the design-build contract delivery method, which is a new approach for King County. Under this method, a single contractor is responsible for both the design and construction of the project after being awarded the contract. Table 9 shows the major scheduling activities under this approach, with an estimated completion time during winter 2010.

Table 9
Marine Outfall Schedule as of June 25, 2004

Activity	Early Start	Early Finish
Prepare solicitation document	15 JAN 07	13 JUL 07
Design-Build procurement	16 JUL 07	15 JAN 08
Design development	16 JAN 08	15 JUL 08
Fisheries marine construction moratorium	16 FEB 09	15 JUL 09
Procure materials and construction	16 JUL 08	15 FEB 10

Risks and Opportunities

During the development of the Brightwater Final Environmental Impact Statement, King County began a process to identify and prioritize potential risks and opportunities that might affect the cost and schedule of constructing the Brightwater facilities. This process was to coincide with the completion of 30 percent design process. King County received the draft Risk Register in June 2004, and while the findings are preliminary at this time, they are sufficient to highlight the importance of having contingency in the construction schedule.

This Risk Register was developed through interviews with key Brightwater consultants and staff beginning in early 2003; the cost and schedule for constructing Brightwater were estimated using a set of reasonable assumptions. Risks and opportunities reflected abnormal conditions that were outside those assumptions and could affect the project's cost and schedule to varying degrees depending on how much they deviated from the assumptions. The Register describes risks and opportunities in terms of their impacts on project cost and schedule and the

likelihood that they would occur, both of which depend on the magnitude of events, that is, how much they varied from assumed conditions. For example, small events may have relatively small impacts but may be relatively likely to occur, whereas large events may have relatively large impacts but may be relatively unlikely to occur. Risks reflect adverse impacts on project cost and schedule, whereas opportunities reflect beneficial impacts on project cost and schedule.

Once the project risks and opportunities have been identified and assessed, they can be combined with the project cost and schedule estimate to determine the uncertainty in the actual project cost and schedule. In addition, the risks and opportunities can be prioritized and ways to reduce the critical risks can take advantage of the opportunities. In fact, even during the development of the Risk Register, the Brightwater project design and project delivery were changed to respond to some of the identified risks and opportunities. This will continue throughout the life of the project.

The following text summarizes some of the potential risks that could delay the Brightwater project, including project-wide risks, risks associated with construction, and risks associated with land acquisition.

Project-wide Risks

The primary risks to the Brightwater project as a whole include risks related to system demand and permitting. In the last six years, DNRP has seen system demand vary as a result of new population and flow estimates. For example, the projected capacity for the South Treatment Plant has varied between the years 2007 and 2013. Although DNRP projects system demand very accurately overall (plus or minus 10 percent), the potential for sanitary overflows—particularly in North Lake Washington—increases as the Brightwater on-line date approaches. If this were to occur, King County may be forced to accelerate construction at a cost premium; in a worse case, regulators may impose moratoriums on new construction.

Several risks are associated with obtaining permits from federal, state, and local agencies to construct Brightwater. Local agencies may have limited resources to process the permits, delaying the review process and subsequent approvals. Further, the Snohomish County Conditional Use permit process is still undefined. Also, permit denials are a possibility, as are excessive restrictions. For example, potential restrictions affecting the schedule could include vibration, lights, noise, truck traffic, emergency response, erosion control, stormwater control, or community disruption. King County DNRP has sought to mitigate those risks by involving regulatory agencies early in the process to understand concerns and meet the requirements. DNRP has established interlocal agreements with local, state, and federal agencies to provide financial resources for those agencies to meet the Brightwater schedule.

Construction Risks

Constructing a large, technically complex project like Brightwater has many inherent risks that could potentially cause delays, particularly in the construction of the tunnel segments. Some examples include:

- Difficulties staging of numerous major subcontractors
- Discovery of unexpected contamination
- Discovery of archaeological or cultural sites
- Unavailability of needed equipment, materials, or labor
- Excessive abrasion to tunnel boring machine (TBM) due to sand and gravel, which can require frequent cutter changes or cause damage to the TBM
- Poor advance rate of the TBM due to large boulders, or the need to surface at locations other than existing portals for emergency repairs
- Difficulties due to groundwater control problems, leakage, or flooding in the tunnel or portal

King County DNRP is researching a number of these risks during the design process and developing plans to prevent and/or respond to those conditions should they occur; for example, geotechnical and archaeological experts will be available during construction, and constructability reviews will be conducted during the design process.

Land Acquisition Risks

King County DNRP needs to secure a considerable number of parcels and easements in both King and Snohomish Counties to construct the Brightwater facilities. Some of the potential risks associated with land acquisition are highlighted below.

- Difficulty in reaching agreements with landowners, possibly compounded by administrative requirements surrounding a condemnation process
- Difficulty in reaching agreement with Burlington Northern Sante Fe (BNSF) Railroad for a railroad crossing and potentially for a railroad spur to Point Wells (Portal 19) for disposal of spoils or delivery of materials
- Delay in issuance of an aquatics land lease from the Washington State Department of Natural Resources

King County DNRP started negotiations as early as possible in order to ensure that land and easements would be acquired on time. DNRP has an interlocal agreement with the Washington State Department of Natural Resources to ensure the aquatics leases can be prepared on the required schedule.

Phasing Analysis

The updated flow estimates confirmed the need for the Brightwater facilities by 2010, and the project is currently on schedule to meet that timeframe. However, DNRP will continue to evaluate phasing alternatives for Brightwater that will provide flexibility to mitigate risks or to take advantage of opportunities. For example, risks associated with permitting, geology, or property acquisition could potentially delay construction beyond the targeted 2010 on-line date, while opportunities related to efficiencies in construction sequencing, labor staging, or commodity purchasing could be realized by deferring the on-line date by a year or two, potentially saving costs and reducing rate and capacity charge impacts. In either case, DNRP would still need to provide adequate conveyance and storage facilities to protect the North Lake Washington area from overflows for up to the 20-year flow event.

This section begins with an overview of the policy framework for the adopted Regional Wastewater Services Plan, which serves as a basis for identifying which phasing alternatives are being considered and which are outside the framework of the RWSP. It then describes a phasing analysis for Brightwater, including an evaluation of needed storage capacity in the Brightwater conveyance system to potentially defer the on-line date of the system through 2014, as well as an evaluation of sequencing the construction at the Brightwater Treatment Plant for the years 2010 through 2012. The phasing analysis described in this section is based on cost and schedule estimates from the December 2003 Brightwater FEIS (conceptual design). The phasing options will be revisited periodically as the project proceeds.

RWSP Policy Framework

The Regional Wastewater Services Plan identified a set of projects and programs to support the region's rapidly growing population for the next 30 years and beyond. In considering phasing alternatives for the Brightwater project, it is important to understand the existing policy framework of the RWSP as codified in Ordinance 13680. A key policy direction of the RWSP was the construction of a third regional treatment plant and the associated conveyance system, including an outfall to Puget Sound. This policy was implemented on December 1, 2003, with the King County Executive's selection of the Route 9–195th Street System as the final Brightwater alternative. The Executive's approved system included the following components.

- A 36-mgd treatment plant located at the Route 9 site by 2010, with a possible expansion to 54 mgd in 2040
- A marine outfall located in Puget Sound off Point Wells
- An influent conveyance tunnel that begins near Kenmore and runs north and east to the Route 9 site
- An effluent tunnel that begins at the Route 9 site and parallels the influent tunnel eventually turning northwest to the King/Snohomish County boundary and continuing west to Point Wells

During the RWSP planning process, regional leaders evaluated many alternatives before selecting the three-plant scenario, such as expanding the two existing treatment plants, building a smaller north plant initially, and building multiple smaller treatment plants. After careful consideration, the King County Executive, Council, and RWQC ultimately concluded that adding a third treatment plant would provide the greatest benefit to the regional system, as well as the greatest flexibility to manage flows safely and effectively well into the future. For example, a third plant preserves available capacity in the regional system, providing a measure of contingency against uncertainties in population forecasts, new regulations, water conservation estimates, infiltration and inflow estimates, or increased flows from CSOs. A third plant allows the County to more easily incorporate improved technologies for biosolids or advanced wastewater treatment. Building a third plant also distributes impacts equally throughout the county. Further, the Council elected to offload flows from the South Treatment Plant to Brightwater to delay any future expansion at the South Plant until much later in the planning horizon. Other factors considered in the decision were cost, environmental and public health protection, and input from the public and stakeholders.

In May and June 2003, DNRP held two workshops for the Regional Water Quality Committee to review the planning assumptions used to develop the RWSP and the effectiveness of the resulting policies. The workshops also presented sensitivity analyses for varying assumptions on population growth, septic tank conversions, and water conservation potential, along with information on cost estimates and status. At the conclusion of the workshops, DNRP confirmed that the original assumptions still held, and while there were some changes, they did not warrant reconsideration of the Council's decision. For example, the current 30-year population and flow projections were 4 percent less forecasted for the RWSP, but this change did not affect the need for Brightwater by 2010. Nor did other changes, such as the delay in the infiltration and inflow program by one year or the increased flow reductions attributable to water conservation.

DNRP will continue to evaluate conditions that may affect RWSP implementation and policy effectiveness as mandated by Council every three years in the RWSP Update. However, based on the findings of the 2004 Update, the Executive did not recommend any significant changes to the RWSP policy framework. The process of amending the RWSP now could take years because of the necessary council approval, environmental review, and a public process. Not only would that make it difficult to meet the current capacity projections, it would forfeit a substantial investment to date on Brightwater.

Accordingly, the phasing options presented in this report are specific to the approved scope of the RWSP. In particular, they examine options for adjusting the timing of the Brightwater Treatment Plant up to four years beyond the 2010 target. These options could provide contingency to mitigate delays that may arise during permitting and construction without having to pay a premium later to get back on schedule. They may also enable DNRP to use optimal construction scheduling to increase efficiency, save money, and lessen rate and capacity charge impacts. This approach is consistent with the RWSP policies and the RWSP Operation Master Plan, which stipulates that the project be built by 2010 or as soon as possible thereafter.

Timing the Brightwater On-line Date

Two components of a phasing analysis for the Brightwater on-line date are described below. The first component evaluates the needed storage capacity in the Brightwater conveyance system to potentially defer the treatment plant on-line date through 2014. The second component evaluates sequencing the construction of the Brightwater Treatment Plant for the years 2010–2012.

Storage Analysis

To maximize efficiencies, save costs, and mitigate risks, the King County Executive could decide to defer the on-line date of the Brightwater Treatment Plant a short time beyond 2010. One key factor in providing the Executive with the flexibility to make this decision is the amount of available storage in the Brightwater conveyance system to store peak flows from a 20-year storm and prevent overflows to Lake Washington. An overview of the storage alternatives is presented in Table 10, which summarizes the impacts of deferring the Brightwater plant's on-line date through the year 2014. The storage analysis presented in this table is based on the Brightwater system at the conclusion of the Brightwater FEIS; it also assumes that a significant portion of the conveyance system is completed in 2010 for storage and that the flow projections do not change.

Table 10 also shows that the plant startup can be deferred through the year 2013 by utilizing the influent and effluent tunnels constructed between the North Kenmore Portal (44) and the North Creek Portal (41). Deferring the plant until 2011 would require storage for up to 6 million gallons of peak wastewater flow, which could be provided with modifications to the influent tunnel. An additional 5 million gallons of storage would be needed by 2012, requiring the use of both the influent and effluent tunnels and the associated pipes and pumps to transfer the stored flows to the North Creek Pump Station. The facilities required to meet this storage requirement are already part of the design with the exception of a relatively small investment of pumps and piping to get wastewater into the regional conveyance system for treatment at West Point or the South Treatment Plant.

By 2013, the effluent tunnel would need to be enlarged from 10 feet to 11 feet 6 inches (internal diameter) to handle the additional flows. Table 10 shows the changes to capital expenditures through 2014 compared to the base year of 2010. The table shows that, through 2013, there are no significant cost impacts associated with deferring the plant's on-line date. This provides up to three years of contingency to address issues that might delay the start of construction beyond 2010. Phasing beyond the year 2013 is not cost effective because of the need to construct the tunnel from Portal 11 to Portal 44 for storage, a segment that would otherwise not be needed until 2020 or later.

Table 10

Capital Changes for Alternate Brightwater On-line Completion Dates

On-line Date	Storage Volume	Storage Provision	Facility Adds for Phasing ($2003 - millions)	Construction Savings with added time ($2003 - millions)	Additional Admin & Contract Costs ($2003 - millions)	System Cost ($2003 - millions)	Net Present Value ($ millions)	Net Present Value Change from 2010 ($millions)
Note:	(1)		(2)	(3)(5)	(4)			(5)
2010 (base condition)	2.5 MG	With plant on line, storage for peak shaving available in base influent tunnel	--	--	--	$1,349.5	$1,194.4	--
2011	6 MG	10-foot influent tunnel from Portal 44 to Portal 41	$3.0	($5.0)	$14.0	$1,361.5	$1,194.5	$0.10
2012	11 MG	Influent and effluent tunnel from Portal 44 to Portal 41 with minimum 10'0' ID	$3.0	($10.0)	$31.6	$1,374.1	$1,189.3	($5.10)
2013	16 MG	Requires enlarging both influent and effluent tunnels from Portal 44 to 41	$6.0	($10.0)	$49.2	$1,394.7	$1,192.0	($2.40)
2014	22 MG	Requires enlarging both Influent and effluent tunnels from Portal 44 to 41 plus 10-foot tunnel from Portal 11 to 44	$58.0	($10.0)	$63.0	$1,460.5	$1,235.2	$40.80

Notes:

(1) Storage capacity in million gallons needed to prevent overflows during a 20-year storm event.

(2) Facility adds include $3 million to add pumping to use influent for storage on a temporary basis; additional $3 million to use effluent line for storage. Storage beyond 17 MG requires the addition of a tunnel from Portal 11 to 44, at a total project cost of $52 million.

(3) Construction cost savings with added time due to ability to re-use one or two TBM's and to get more competitive bids by spreading work out

(4) Includes added costs for admin and management for time beyond 2010 - Calculated at 12 percent of construction costs and additional costs for extending existing contracts for design and GCCM.

(5) Parenthesis indicates savings in net present value; the present values presented do not include the initial year of capitialized operating expenditure.

Cash Flow Impacts

The cash flow impacts of deferring the Brightwater on-line date through 2014 are shown in Figures 4 and 5. Figure 4 illustrates the relative amplitude of the cash flow expenditures, showing how earlier on-line dates result in "peakier" expenditures while later on-line dates result in smoother expenditures. For example, based on a 2010 on-line date, Brightwater cash flow expenditures would peak during the construction years of 2007–2009, averaging about $250 million per year. By comparison, an on-line date of 2013 results in a smoother cash flow, averaging about $160 million per year during the construction years 2010–2012. Figure 5 uses cumulative cash flow totals to highlight the relative amount and duration of expenditures, showing how earlier on line dates have greater annual expenditures over shorter duration and later on-line dates have smaller annual expenditures or longer duration. In 2014, project costs increase significantly due to the construction of the tunnel section between Portal 11 and 44, which is otherwise not needed.

Rate and Capacity Charge Impacts

For each year the Brightwater on-line date is deferred, approximately $12 million (2003 $) in operating and maintenance (O&M) expenditure is avoided by postponing the startup of the plant, the inclusion of which would substantially increase the rate. The effects of the deferred startup are illustrated in Figures 6 and 7, which show the 30-year rate projections from 2010 through 2014 with and without inflation, respectively. This deferral of O&M expenditures explains the majority of the rate difference between the baseline and the subsequent years shown in Table 11 using levelized rates.[3] However, the overall difference between the highest rate (2010) and the lowest rate (2014) is only $0.23 or less than one percent of the baseline.

Table 11
Rate Estimates for Alternate On-line Dates

On-line Date	2003–2030 Rate (levelized, 2003$)	2005 Capacity Charge
2010 (baseline)	$25.91	$35.20
2011	$25.84	$34.70
2012	$25.77	$33.85
2013	$25.71	$33.35
2014	$25.69	$34.55

[3] The levelized rates presented are adjusted to remove inflation and provide a means of comparing alternatives with different rate patterns over time.

Figure 4
Brightwater Conveyance System Cash Flow Scenarios
Based on Brightwater FEIS Costs (2003$)

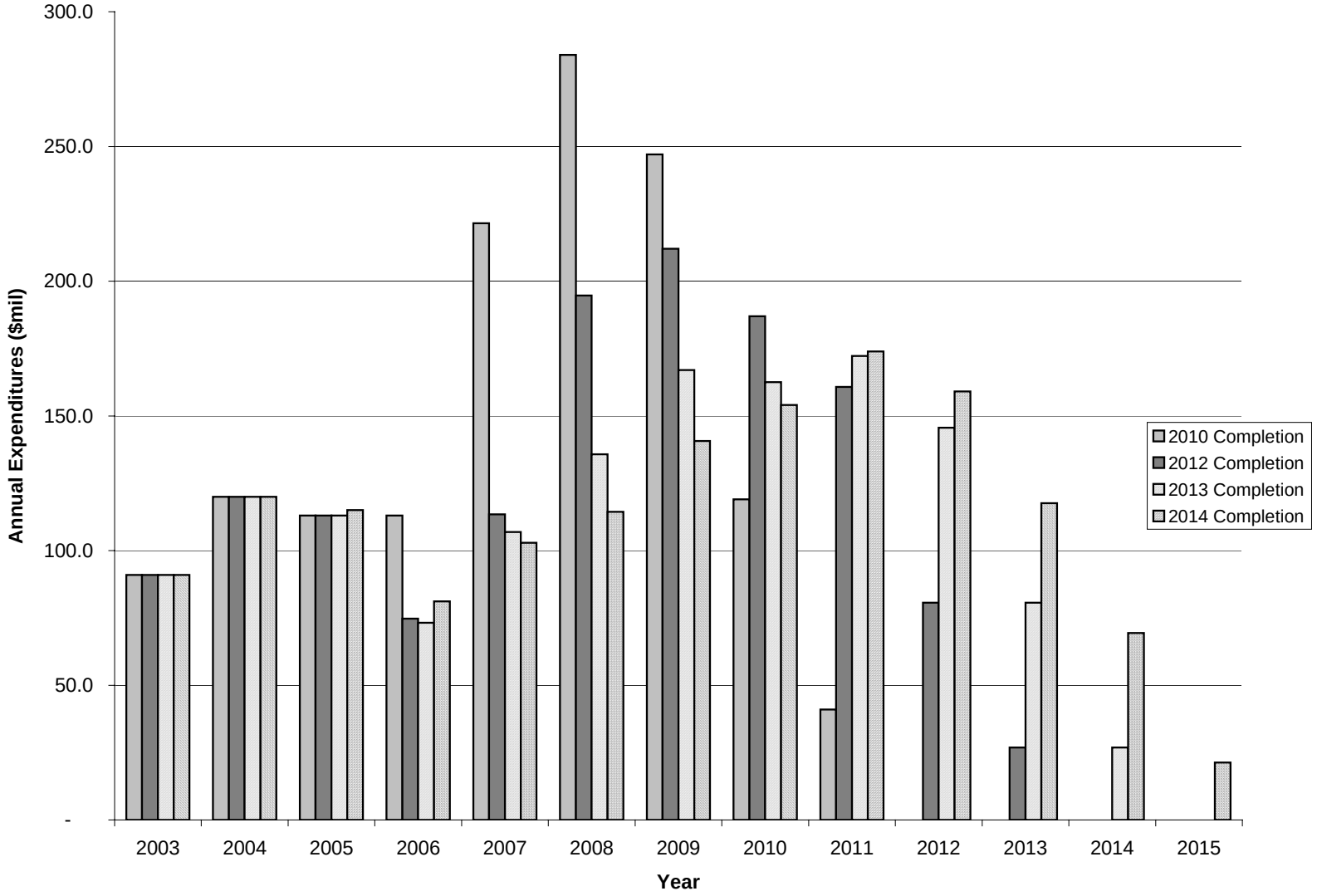


Figure 5
Brightwater Program Cumulative Total Cash Flow
Based on Brightwater FEIS costs (2003$)

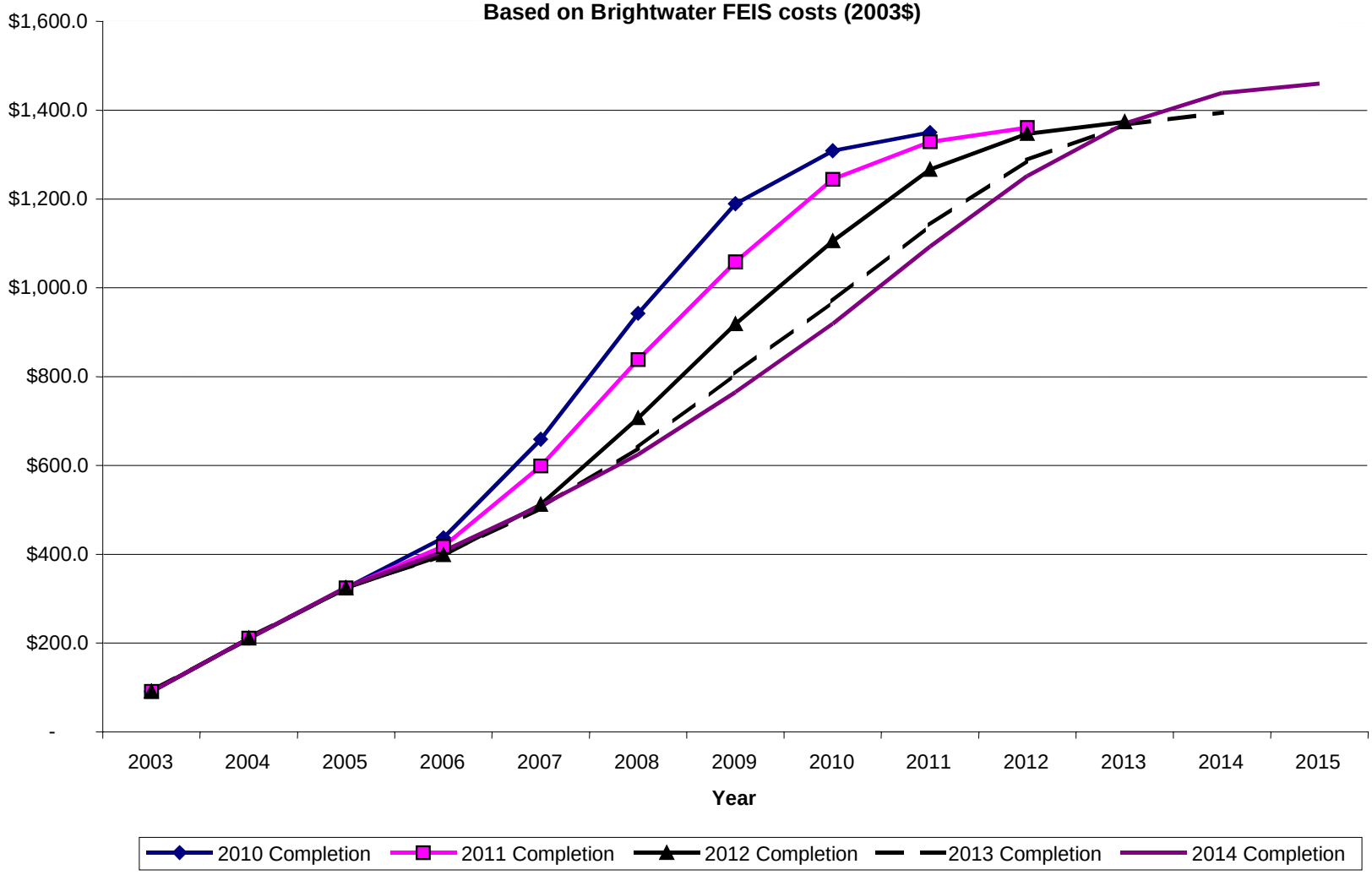


Figure 6
Monthly Sewer Rate Projections for Alternate Brightwater On-line Dates (without Inflation)
Based on Brightwater FEIS (2003 $)

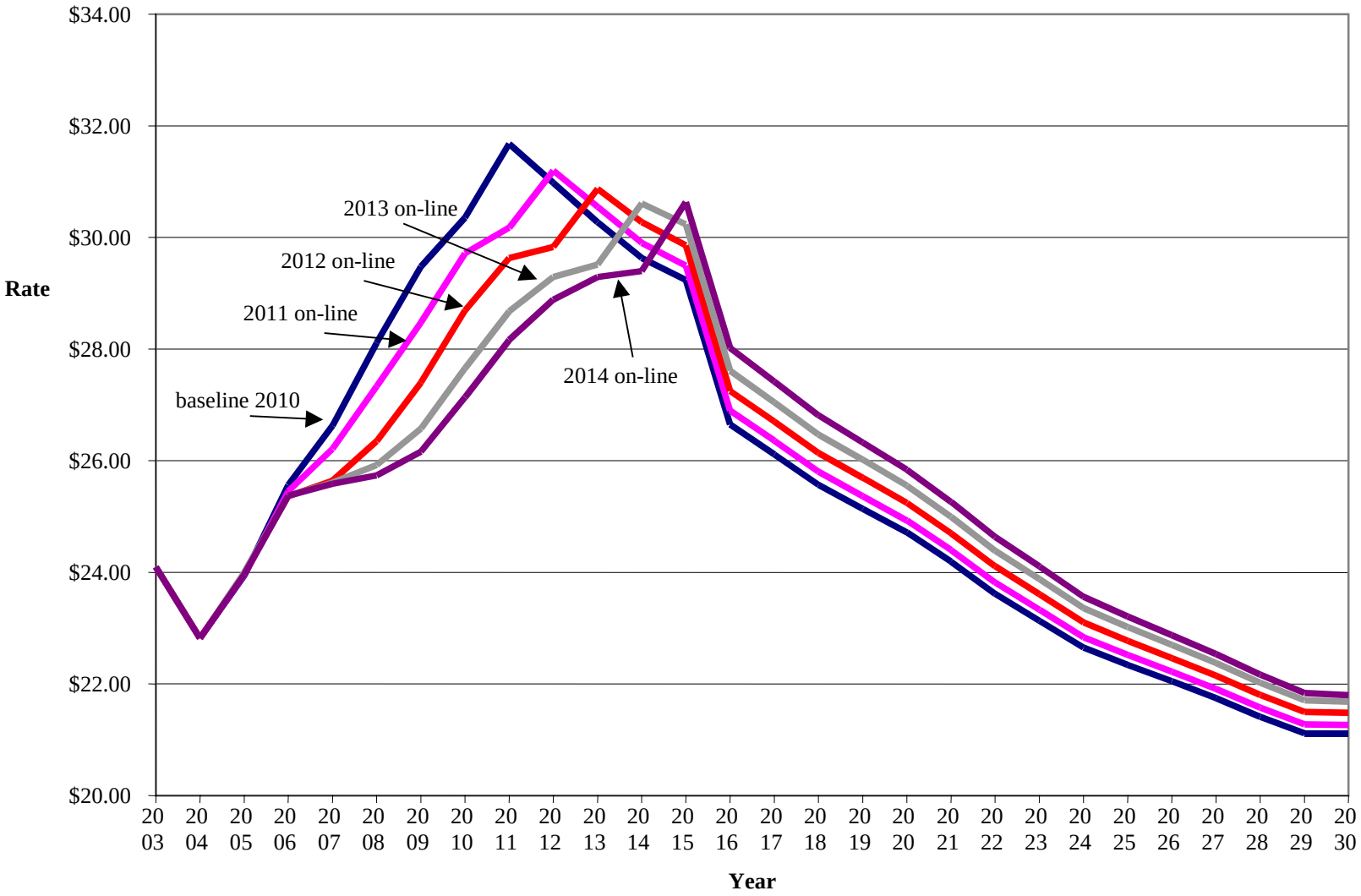
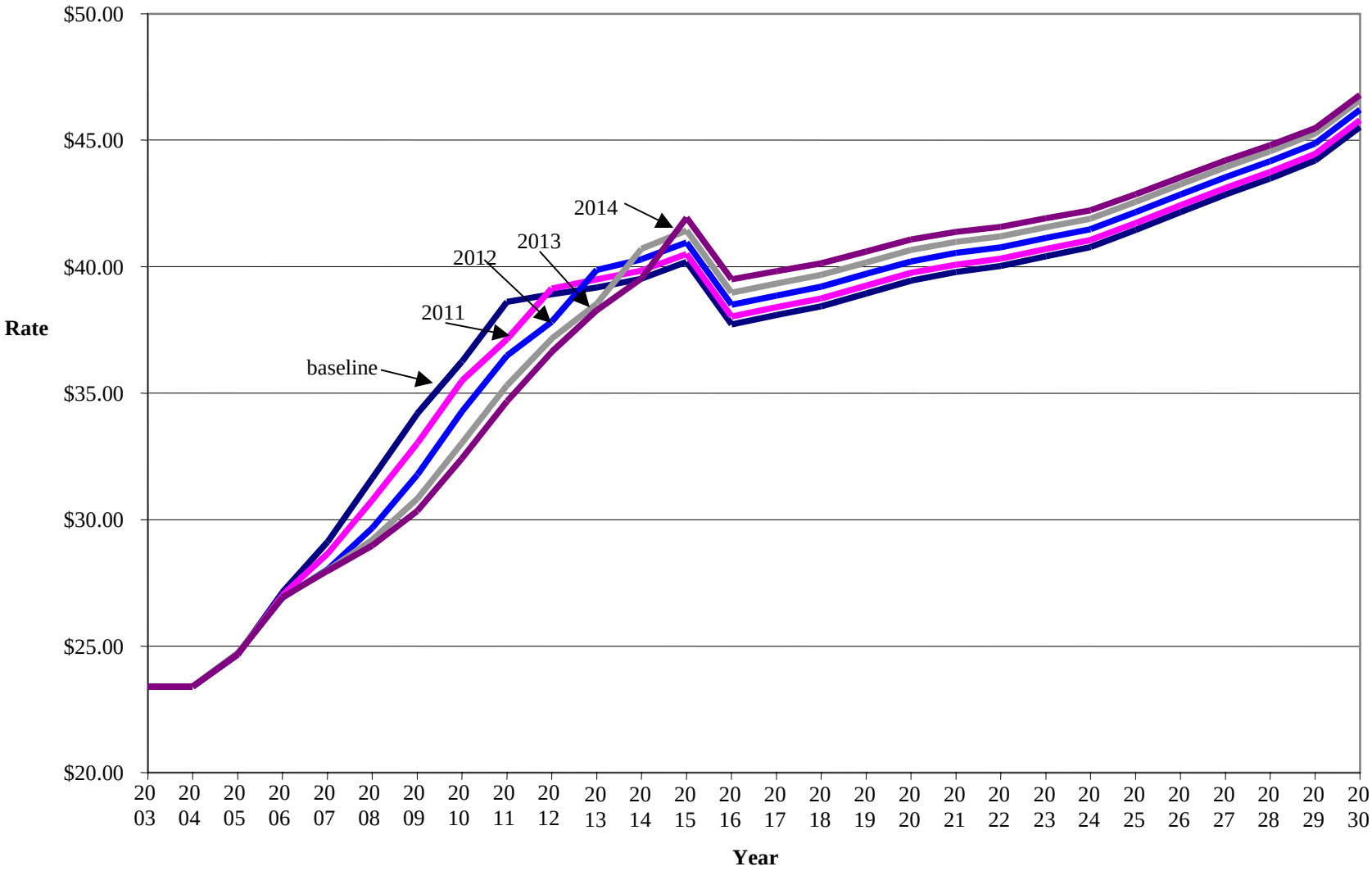


Figure 7

Monthly Sewer Rate Projections for Alternate Brightwater On-line Dates (with Inflation)

Based on Brightwater FEIS (2003 $)



The reason the rates are lowest in 2014 is because, by delaying start up to 2014, the O&M expenses are not incurred until 2015, thereby avoiding approximately $48 million (2003 $) in operating expenditure relative to a 2010 startup. Additionally, though not having as strong an effect on the rate, the later the start up the later the initial year of O&M is incurred, creating present value savings in capital expenditure of approximately $200,000 per year of deferral.

The capacity charge is influenced primarily by the change in capital expenditure patterns and levels presented in Table 10. As with the cash flow and rate analyses, the overall differences between the alternatives are modest.

As the Brightwater phasing options are refined and costs and schedules are finalized, DNRP will explore a number of financing options to defer debt service to help smooth rate impacts over time. Appendix C presents a summary of the types of financing options that will be considered. The King County Executive will include specific financing options in future rate and capacity charge proposals to Council.

Construction Sequencing

The treatment plant schedule developed for the Brightwater FEIS assumed construction start in the summer of 2005. Site preparation and grading activities would commence at that time followed by mass excavation in 2006 and 2007 to prepare the site for concrete placement for treatment plant foundations, tanks, buildings, and galleries in the 2008 timeframe. Piping, electrical and equipment installation would occur in 2007–2009. Testing and start-up of the basic treatment facilities would be completed in 2010 timed to coincide with completion of the conveyance system. The total duration of construction allowed was 4 years allowing an additional 6–12 months for start-up, testing, and facility commissioning.

The Washington State Department of Transportation is planning to widen Highway 9—the main access road to the treatment plant—in 2005 and 2006. If the treatment plant and the highway were constructed concurrently, there would be substantial traffic impacts. Options were developed in the FEIS to mitigate the impact such as construction of an access road on the south end of the treatment plant site or to defer major construction activities until after 2006 when the highway is complete to minimize traffic impacts. The conveyance system is on the critical path and will take longer to construct. This leaves some flexibility in the schedule for the treatment plant construction.

A recent development affecting construction scheduling for the treatment plant was withdrawal of the appeal of the Brightwater FEIS by Stockpot Soups as a result of a settlement agreement reached with King County DNRP. King County agreed to not initiate construction of the treatment plant until July 2006 to allow Stockpot additional time for continued operation and relocation. Starting construction in 2006 compresses the construction schedule assuming a completion date of 2010 and could lead to a less than optimal construction schedule and phasing.

King County DNRP has coordinated with the treatment plant general contractor-construction manager (GCCM) to evaluate construction schedules that assume completion dates between 2010 and 2012. Based on this effort, DNRP has determined that there is flexibility within this timeframe to optimize the construction schedule to increase efficiency and potentially reduce costs. This flexibility could further allow DNRP to better react to market conditions for commodities, accommodate delays, and maximize labor workflow.

Conclusions

This report is the first in a series of quarterly reports intended to provide the King County Council with up-to-date cost, schedule, and status information on the Brightwater project. This report presented a summary of the preliminary value engineering recommendations based on 30 percent design. It also presented information on available capacity in the wastewater system, the Brightwater construction schedule, potential risks, and an analysis of phasing the Brightwater on-line date, including the associated impacts on monthly rates and capacity charges. This report did not include the cost estimates the project because they are still under review. The final cost estimates will be included in an addendum to this report in late September along with the final VE recommendation and their associated cost impacts.

A key conclusion from this report is that the Brightwater project is still required to provide needed wastewater capacity to the north service area by 2010. The Brightwater project is currently on schedule to meet this timeframe; however, by using the Brightwater influent tunnel as an interim storage facility, flexibility is available between the years 2011 and 2012 to phase construction of the treatment plant. This flexibility would allow the King County Executive to accommodate delays or mitigate risks that may arise during final design, permitting, and construction without paying a cost premium to get back on schedule. The Executive could also take advantage of this flexibility to optimize the construction schedule, maximize labor workflow, react to market conditions for commodities, and lessen rate and capacity charge impacts.

These conclusions are supported from the findings from this report. First, in terms of system capacity, while the updated 2003 population forecasts show a 4 percent reduction in total sewered population since the RWSP, the north service area flows are 4 percent higher overall than previously estimated. This increase, combined with the bottleneck in conveyance capacity in the north service area, hydraulic capacity limits at the South Treatment Plant, and solids handling issues at West Point, makes it imperative that Brightwater be constructed on time.

Second, in terms of schedule, the June 2004 construction schedule presented in this report shows that the Brightwater system will be completed in October 2010. However, there are risks associated with the construction of large, complex capital projects such as Brightwater, including delays in obtaining permits, problems with construction, or difficulties in acquiring needed easements or property. To provide contingency to help mitigate such risks, King County DNRP conducted a phasing analysis to evaluate alternate on-line dates for Brightwater system.

The phasing analysis included two components. The first was the ability of the Brightwater conveyance system to store wastewater flow in the event the treatment plant was delayed. The analysis showed that the Brightwater conveyance system could store additional flows through the year 2013 with only modest improvements in pumps and piping. By 2014, however, the costs for storage became prohibitive.

The second component examined the effect of sequencing the treatment plant construction, which showed flexibility in the years 2011 and 2012 to maximize the construction workflow, balance labor demands, and reduce cash flows in peak construction years. However, inflationary risk became a factor in 2013.

In summary, this report demonstrated that the King County Executive has the flexibility to adjust the final Brightwater completion date through 2012 as needed to accommodate delays or mitigate risks without paying a premium to get back on schedule. This flexibility will also allow him to take advantage of potential opportunities to react to market conditions, employ labor efficiently, and smooth cash flows in peak construction years. Accordingly, the Executive recommends continuing with the present schedule to complete Brightwater in the fall of 2010, using the available flexibility as needed to construct Brightwater as efficiently and cost effectively as possible.

Appendix A – Current System Capacity

In 1998, King County's Wastewater Treatment Division prepared population forecasts and wastewater flow projections for its wastewater service area in order to develop the Regional Wastewater Services Plan (RWSP). The forecasts extend to the year 2050 when it is assumed that population will reach saturation—the full buildout of developable land in the service area. In 2003, WTD updated these forecasts and projections as part of the 2004 update to the RWSP.

Updated Population Forecasts

To identify future wastewater facility needs in its service area, WTD projects future wastewater flows based on population and employment forecasts provided by the Puget Sound Regional Council (PSRC).[4] The PSRC data used for the RWSP was based on the 1990 census; the 2003 forecasts were based on the 2000 census.[5] Analysis of the updated PSRC data demonstrates that the RWSP population and employment forecasts within the King County wastewater service area are similar to the updated forecasts in terms of total sewered population, as shown in Table A1.

Table A1
RWSP and Updated Forecasts of Sewered Population (1990–2030)

	Sewered Population (Residential + Commercial + Industrial)		
Decade	RWSP Forecasts[a]	Updated Forecasts[b]	Percent Change
1990	2,053,746		
2000	2,372,701	2,462,476	3.7%
2010	2,739,328	2,769,130	1.1%
2020	3,106,175	3,148,747	1.4%
2030	3,411,920	3,455,896	1.2%
Percent Change 2000–2030	44%	40%	

a. Based on Puget Sound Regional Council forecasts by Forecast Analysis Zones (FAZs) in 1995, which used 1990 census data.

b. Based on Puget Sound Regional Council forecasts by Traffic Analysis Zones (TAZs) in 2003, which used 2000 census data.

[4] Information cited in this section is from the May 2004 document titled *Population and Flow Analysis by Wastewater Basin – Supplement to the 2004 Update to the Regional Wastewater Services Plan*.

[5] PSRC forecasts population growth through 2020; King County extends this forecast through 2050.

Table A1 shows that the 2003 forecasts are 4 percent below the RWSP forecasts for the total sewered population for residential, commercial, and industrial categories from 2000 to 2030. The updated 2003 forecasts show a 40 percent growth in sewered population for the same period. However, while the residential and industrial populations were similar to those predicted for the RWSP for the year 2000, the 2003 forecasts identified 65,000 more commercial employees than were predicted for the RWSP—mostly in the service area for the South Treatment Plant. In addition, commercial employment was lower in Seattle than was forecast for the RWSP.

Updated Flow Projections

Wastewater base flows are calculated by applying unit flow factors to the population and employment forecasts; for example, a residential flow factor is approximately 60 gallons per capita per day. Wet weather and peak flows are then calculated by factoring in infiltration and inflow and water conservation factors. King County uses average wet-weather flow (AWWF) to evaluate available capacity at the treatment plants; peak flows are used to size the conveyance system at buildout because the lifetime of the facilities can easily go beyond 50 years.[6] Treatment plants can be constructed in phases, so they are usually built in increments to handle the hydraulic peak as the region grows.

Solids handling is also a critical factor in determining the timing for new treatment plant facilities. Solids are estimated by applying unit-loading factors to the population and employment forecasts. Biological oxygen demand and total suspended solids are measured daily so that there is regular data to be used to estimate future solids loading. Actual solids volumes that leave the plants as biosolids are also measured and used to back calculate in-plant facility needs.

Systemwide Capacity

For 2000, the measured AWWF for the entire service area was 7 mgd less than predicted for the RWSP. The actual flow in Seattle was lower than predicted; the actual flow in the South plant service area (primarily on the east side) was higher than predicted. The RWSP assumptions for wet-weather infiltration and water conservation levels account for the difference between predicted and actual 2000 AWWF in Seattle. The RWSP assumption for wet-weather infiltration was too high, and the assumption for water conservation was too low. A decrease in AWWF is expected to occur in Seattle between 2000 and 2010. This decrease results from water conservation and from recent removal of Green Lake flows from the wastewater system. The flow will steadily increase after 2010 at the same rate as predicted in the RWSP.

[6] Peak 20-year flow is the flow that would be expected once every 20 years, on average, based on 50- or 60-year simulations of current conditions

South Treatment Plant Capacity

Although the updated AWWF projections for the entire service area are slightly lower than predicted for the RWSP, the projections show higher initial population and greater growth in the south end of the service area than was originally assumed. It now appears that the South plant could reach its rated design capacity sooner than expected, potentially by 2007 (Figure A1). A study is currently underway to examine ways to increase capacity at the South Plant until Brightwater is on line. DNRP will continue to monitor actual population and flow against the projections and begin design to expand or rerate the South plant if needed. In the long term, the South Plant may have to be upgraded earlier than projected in the RWSP, possibly as soon as 2023 (versus the year 2029 identified in the RWSP) if population forecasts hold true and water conservation does not improve.

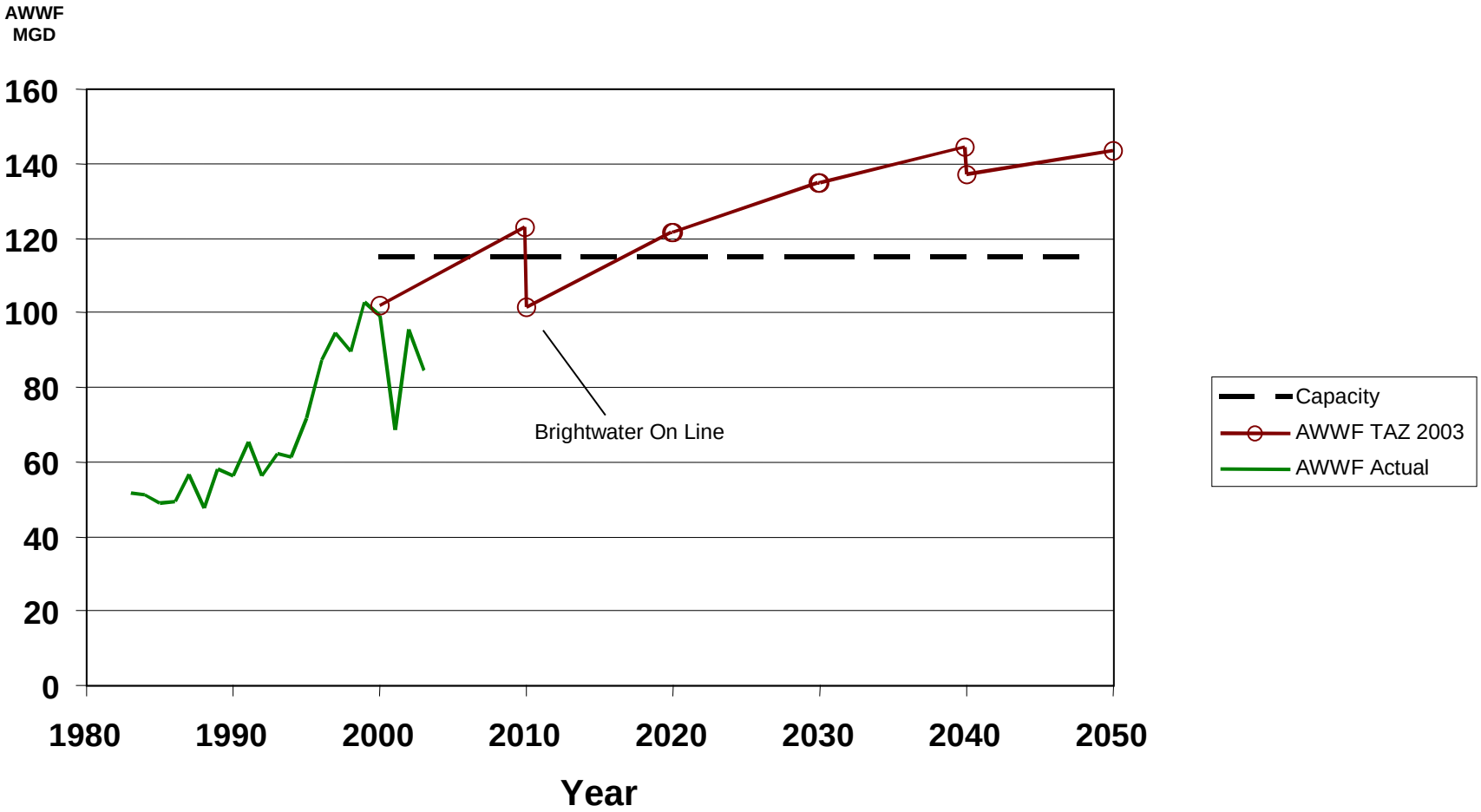
West Point Treatment Plant Capacity

A decrease in AWWF is expected to occur in Seattle between 2000 and 2010, providing the West Point Treatment Plant with additional liquids capacity beyond 2010 (Figure A2). The actual flow in Seattle was lower than predicted in the RWSP because the RWSP assumption for wet-weather infiltration was too high and the assumption for water conservation was too low. This decrease results from water conservation and from recent removal of Green Lake flows from the wastewater system. The flow will steadily increase after 2010 at the same rate as predicted in the RWSP. However, while West Point does have additional hydraulic capacity beyond 2010 to handle average flow, the plant will always have a fixed peak wet weather capacity and on occasion has difficulty operating during peak wet weather conditions. Further, there is insufficient digester capacity to handle the additional solids as well as insufficient conveyance capacity to get the flows to West Point because of limitations in the north end conveyance system, as described below.

North End Conveyance Capacity

The north service area continues to be a major constriction in the system. Based on model results done in 1998, King County estimates that the Kenmore Interceptor and upstream storage and flow transfers to Edmonds will reach capacity no later than 2010. This assumption is supported by recent checks against the model, comparing our 1998 modeled peak flows for basins discharging to the Lake Line for the year 2000 against updated flows modeled using actual rainfall data from the 2001–2002 wet season. The model results showed that peak 20-year flows in the Brightwater service area in 2000 are 4 percent higher overall than previously estimated and that some basin flows to the Kenmore Interceptor are higher than anticipated for 2000. These findings confirm that our original estimates for needing capacity in 2010 are still valid.

Figure A1
2003 Updated South Plant Average Wet Weather Flow (AWWF)



Includes Woodinville & North Creek through 2010

Figure A2
2003 Updated West Point Average Wet Weather Flow (AWWF)